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(71) Applicant: **SAPIM AMADA S.p.A.**
**I-36045 Lonigo (Vicenza) (IT)**

(72) Inventor: **Codatto, Antonio**
**I-36045 Lonigo, Vicenza (IT)**

(74) Representative: **Bettello, Pietro, Dott. Ing. et al**
**Studio Tecnico**
**Ingg. Luigi e Pietro Bettello**
**Via Col d'Echele, 25**
**36100 Vicenza (IT)**

## (54) A cutting device with movable punch

(57) A punch (7) having a central part (12), said central part (12) being equipped with a multiplicity of radial projections (13) and with a multiplicity of slots (16), said projections (13) having an external lateral surface (14), a seat (2) having a surface (15), said external lateral surface of said projections being in contact with said surface (15) of said seat (2), a shaped element (8) comprising a flange (17), said flange having a bottom, said bottom being equipped with a multiplicity of rods (18), said rods engaging with said slots (16) in the interior thereof, and a blank - holder (9) being integral with the ends of said rods.

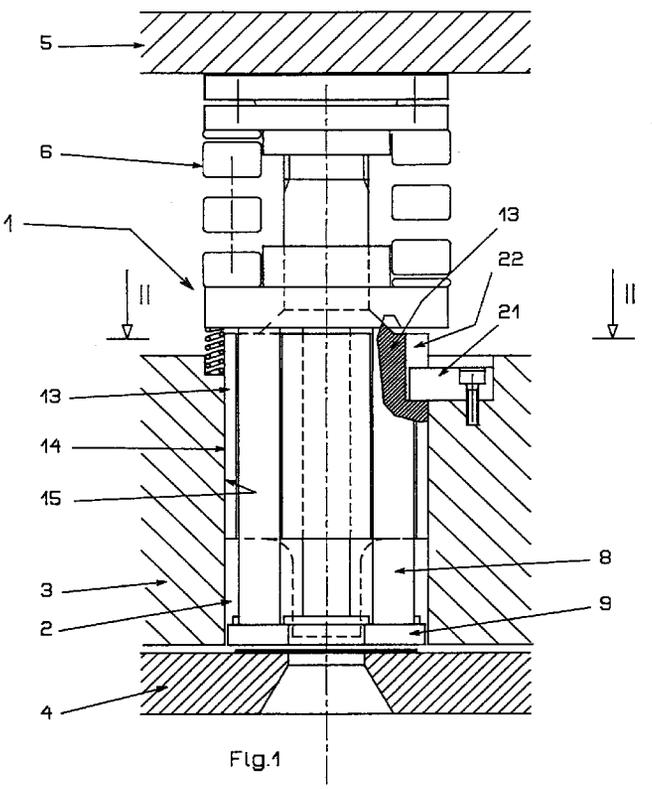


Fig.1

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## Description

### FIELD OF THE INVENTION

The present invention relates to a cutting device for performing the operation of cutting metal sheets, according to the general part of Claim 1.

### BACKGROUND OF THE INVENTION

In the industrial field the operation of cutting is a mechanical operation by means of which one piece of metal is detached from another by working with special tools which are capable of cutting.

This operation is performed by applying a suitable pressure with the tool (blade or punch) in one area of the material so as to make it slide with respect to the others.

The tool used is a blade if the cuts to be made are open but it is a punch if the cuts are of closed profile.

The cutting is a very rapid operation, it produces well-defined shapes in an instant and is particularly suitable for the working of metal sheets.

Opposite to the tool, which has a rectilinear movement, is the die, in fixed position, which functions as support for the metal sheet and enables it to be cut.

Initially the tool displays its action with a compression of the material, causing a plastic deformation to take place which creates a hollow body; in the subsequent phase, the compression force, which increases gradually, reaches and exceeds the value of the shear strength thus producing the detachment of a portion of metal sheet.

During the cutting operation, the fibres of the metal sheet, adjacent to the cutting corner of the punch, are bent following the movement of the tool for a short path prior to the stage when they are finally cut, so that they are compressed and deformed along the entire cut contour.

In particular, because of the elasticity of the material, internal reactions occur, in correspondence with the cut fibres, and these reactions cause the appearance of appreciable friction between the slide walls and this friction prevents the exit of the cut disc from the die and the removal of the punch from the hole of the metal sheet.

For the purpose of avoiding these drawbacks, a blank-holder is used which, by acting by compression in the vicinity of the edge to be cut, from the time prior to the action of the punch and until the latter is completely retracted, prevents the deformation of the cut fibres.

In the current state of technology, the industrial machines which perform the cutting of metal sheets by means of punching are so equipped as to have a punching assembly essentially constituted by the punch itself, the die underneath and a flexible element which moves the above mentioned punch.

The punch is held in a guide and can slide in the interior of a body known as a punch guide which also has the function of holding, at its lower end, the eventual blank-holder element should the use of this be required.

In its turn, the punch guide can slide within the seat machined on the bearing structure of the machine.

Structurally speaking the punching assembly therefore has two coaxial cylindrical profiles, in each of which is provided the coupling between, the surface of the body which constitutes the hole and the surface of the body which constitutes the shaft. This coupling, being of the guide type, therefore requires that the two surfaces have to be machined to tolerance and with a very low degree of roughness.

Furthermore, in correspondence with each of the above mentioned profiles, a mechanical element, a key or other element, must be provided which is capable of preventing the relative displacement between the element which constitutes the hole and the element which constitutes the coupling shaft.

From the above it will therefore be apparent that the production of a punch assembly requires the machining, to tolerance and with a minimum degree of roughness, of at least four surfaces, i.e. those constituting the two couplings and the creation of at least two seats for the housing of the associated stop keys; all this involving increased costs requiring considerable accuracy between the die and punch.

### SUMMARY OF THE INVENTION

The object of the invention is to provide a punch which has a profile shaped in such a way as to reduce, as far as cutting in half, the mechanical operations to be carried out to produce the component pieces, with respect to those which are necessary in order to produce the similar punches which are already known today and a punch which is also interchangeable with the known punches at the same time.

This object is achieved by providing that the body of the punch has, in addition to an upper shank which engages with the flexible means and a lower end which functions as a cutting blade, also radial projections, parallel to the axis of the body and developed in height as much as the above mentioned body and having their external surface coupled to the surface of the housing hole or seat machined on the structure of the machine.

With this novel solution the centering and the guiding of the central punch are achieved without requiring recourse to the use of the intermediate punch-guide body, which is indispensable in the current operations.

When the use of the blank-holder is required, the further novel feature of the invention resides in the fact that the same blank-holder is integral with a shaped element, placed above it, this element partially engaging in recesses produced on the body of the punch. These recesses have the dual function of centering and guiding the shaped element and, therefore, the blank-holder located underneath it.

The advantages of the punch according to the invention are evident from the above because the punch

requires a single coupling to tolerance and has the surfaces in contact having minimum roughness, precisely in correspondence with the external surface of the projections of the punch and with the surface of the housing seat, as well as a single mechanical stop point (key) to prevent the rotation of the same punch.

Advantageously, therefore, the machining of the other surfaces of the body of the punch, excluding the surface in contact with the fixed seat, as well as the production of the entire shaped body and of the blank-holder anchored to it, can be carried out with mechanical processes which are not precision processes, with a considerable time saving and hence a considerable reduction in costs.

A preferred configuration of the shaped element comprises a flange, equipped at the bottom with a multiplicity of rods placed in circumferential fashion and having their end integral with a disc, which functions as blank-holder and as connection element between the same rods.

The blank-holder can be an element which is connected in movable manner to the rods or, in punches of smaller dimensions, may be an integral part of the body of the rods.

These and other features of the invention will be more clearly described by means of the description of some of its possible embodiments, given solely by way of non-limiting examples, and with the aid of the accompanying drawings, in which:

Fig. 1 is a front view, partially in cross section, of the punch assembly of this invention in the working position;

Fig. 2 is a plan view, in cross section according to line II-II of Fig. 1 of the punch assembly, in the working position;

Fig. 3 is a front view, in cross section according to line III-III of Fig. 4, of the punch assembly;

Fig. 4 is a plan view, in cross section according to line IV-IV of Fig. 3, of the punch assembly;

Fig. 5 is a front view of the punch;

Fig. 6 is a plan view, partially in cross section according to line VI-VI of Fig. 5 of the punch;

Fig. 7 is a front view, partially in cross section according to line VII-VII of Fig. 8, of the shaped element;

Fig. 8 is a plan view, partially in cross section according to line VIII-VIII of Fig. 7, of the shaped element;

Fig. 9 is a front view, partially in cross section, of the blank-holder;

Fig. 10 is a plan view of the blank-holder;

Fig. 11 is a front view in cross section of the punch assembly, with a punch of considerable dimensions;

Fig. 12 is a front view in cross section according to line XII-XII of Fig. 13, of a punch assembly, with a punch of small dimensions;

Fig. 13 is a plan view in cross section according to line XIII-XIII of Fig. 12, of the punch assembly;

Fig. 14 is a front view of the punch assembly of Fig. 12.

As shown in Figs. 1-10, the punch assembly 1 is placed inside the seat 2 machined on the fixed structure 3 of the machine tool, which has the die 4 at the bottom, the movable upright 5 and the elastic element 6 at the top.

The punch assembly 1 comprises the punch 7, placed in a central position in the seat 2, the shaped element 8, coaxial with the punch 7, and the blank-holder 9, integral with the terminal section of the same element 8.

The punch 7 is characterized by the fact that it has, in addition to the upper shank 10, which engages with the elastic element 6 and with the shaped end 11, which functions as the cutting blade, also a central part 12, the latter being equipped with a multiplicity of radial projections 13, parallel to the axis of the same punch.

The external lateral surface 14 of the projections 12 coming into contact with and being coupled to tolerance to the surface 15 of the seat 2, machined in the body 3, ensures the guiding and centering of the punch 7.

The projections 13 delimit slots 16 which are parallel to the axis of the punch 7, and entering the body 12 of the punch.

The shaped element 8 comprises a flange 17, the bottom of which is equipped with a multiplicity of rods 18 which engage in the recesses 16 machined on the pin 7, after the above mentioned element 8 is placed in a coaxial manner with respect to the pin 7.

The profile of the cross-section of the rods 18 is similar to but of dimensions slightly smaller than the profile of the corresponding slots 16 within which the rods 18 engage, thus ensuring the positioning of the entire shaped element 8.

The blank-holder 9 is anchored to the end of the rods 18 by means of a movable connection with the screws 19 and the projection 20.

To prevent the rotation of the punch 7 about its own axis, a key 21 is provided which is integral with the body 3 and which engages with the punch 7 by means of the slot 22.

The principal advantage which characterizes the form of the entire punch assembly 1 described above lies in the fact that the only surfaces which require pre-

cision mechanical machining, i.e. to tolerance and with a minimum degree of roughness, are the external surface 14 of the projections 13 and the two walls of the slot 22 in contact with the key 21.

It therefore follows that all the other surfaces which constitute the three elements of the punch assembly 1 can be produced with mechanical operations which are not precision machinings and therefore with a considerable saving of both time and money.

The form of the radial projections 13 as well as the number and the cross-section of the rods 18 are variable as a function of the type of punch 7, as can be seen in Fig. 11, which shows a structural form of the punch assembly with a punch 7 of large dimensions.

When a punch 7 has a reduced cross-section, as shown in Figs. 12, 13 and 14, the shaped element 24 has the end 25 configured in such a way as to function as a blank-holder.

## Claims

1. In a machine for cutting a metal sheet which comprises a die (4) at the bottom thereof, a movable upright (5), an elastic element (6), said machine having a fixed structure (3), a seat (2) formed in said fixed structure, a punch assembly (1), said punch assembly (1) having movable punch (7) placed within said seat (2), a shaped element (8), said element (8) being coaxial with said punch (7) and having a terminal end at the bottom thereof, a blank-holder (9), said blank-holder being integral with said terminal end of said shaped element (8), said punch assembly being characterized by the fact that the punch (7) has a central part (12), said central part (12) being equipped with a multiplicity of radial projections (13) and with a multiplicity of slots (16), said projections (13) having an external lateral surface (14), said seat (2) having a surface (15), said external lateral surface of said projections being in contact with and coupled to tolerance with said surface (15) of said seat (2), said shaped element (8) comprising a flange (17), said flange having a bottom, said bottom being equipped with a multiplicity of rods (18), said rods engaging with said slots (16) in the interior thereof.

2. The punch assembly according to claim 1 wherein said slots (16) have a profile, said rods (18) have a cross-section with a profile, said profile of said rods being similar to and of smaller dimensions than said profile of said slots (16).

3. The punch assembly according to claims 1 or 2, characterized by the fact that it is equipped with at least one mechanical element (21) integral with said structure (3), said punch (7) having a slot (22) corresponding to one of said projections (13), said mechanical element (21) engaging with said slot (22).

4. The punch assembly according to one or more of the preceding claims characterized by the fact that the shaped element (24) has an end (25), said end being configured in such a way as to function as a blank-holder.

5. The punch assembly according to claim 3, characterized by the fact that said slots (22) have two walls, said punch assembly (1) provides for the machining to tolerance and with a minimum degree of roughness of said external surfaces (14) of said projections (13) and of said two walls of the slots (22).

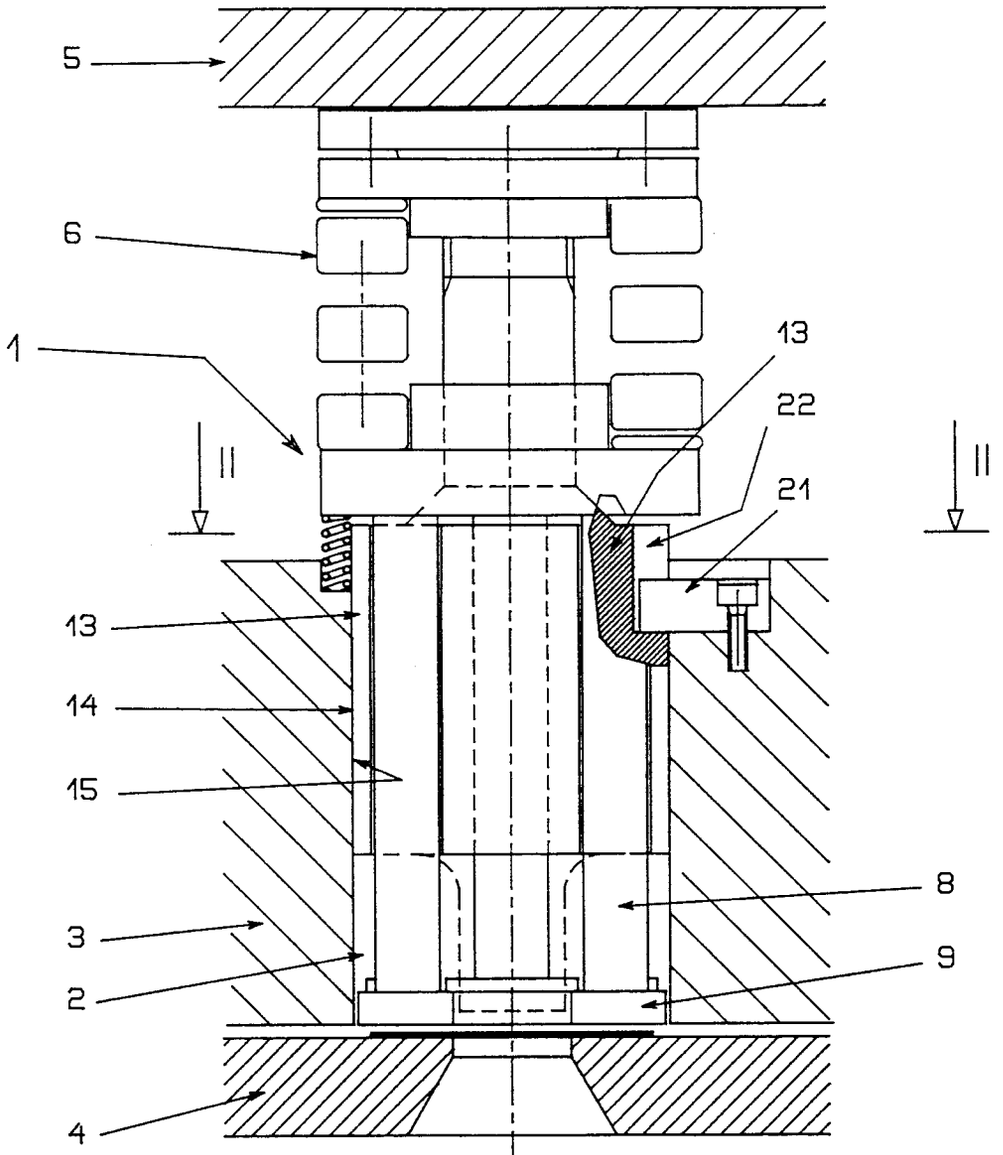


Fig.1

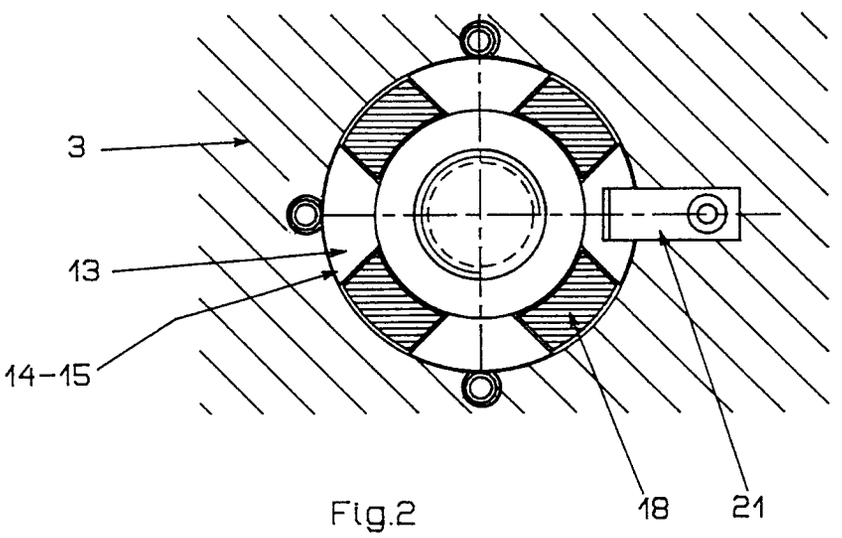


Fig.2

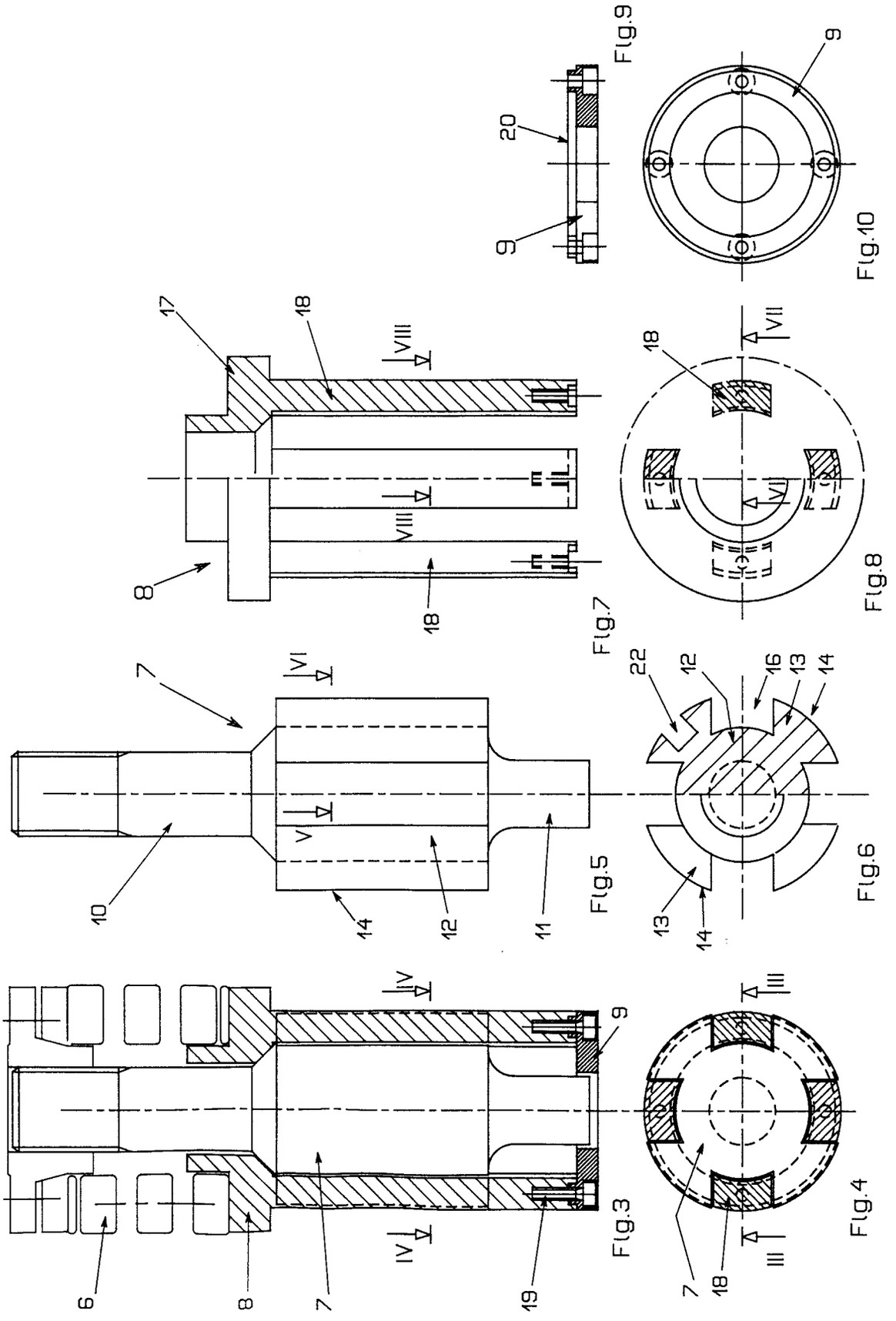
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Fig.10

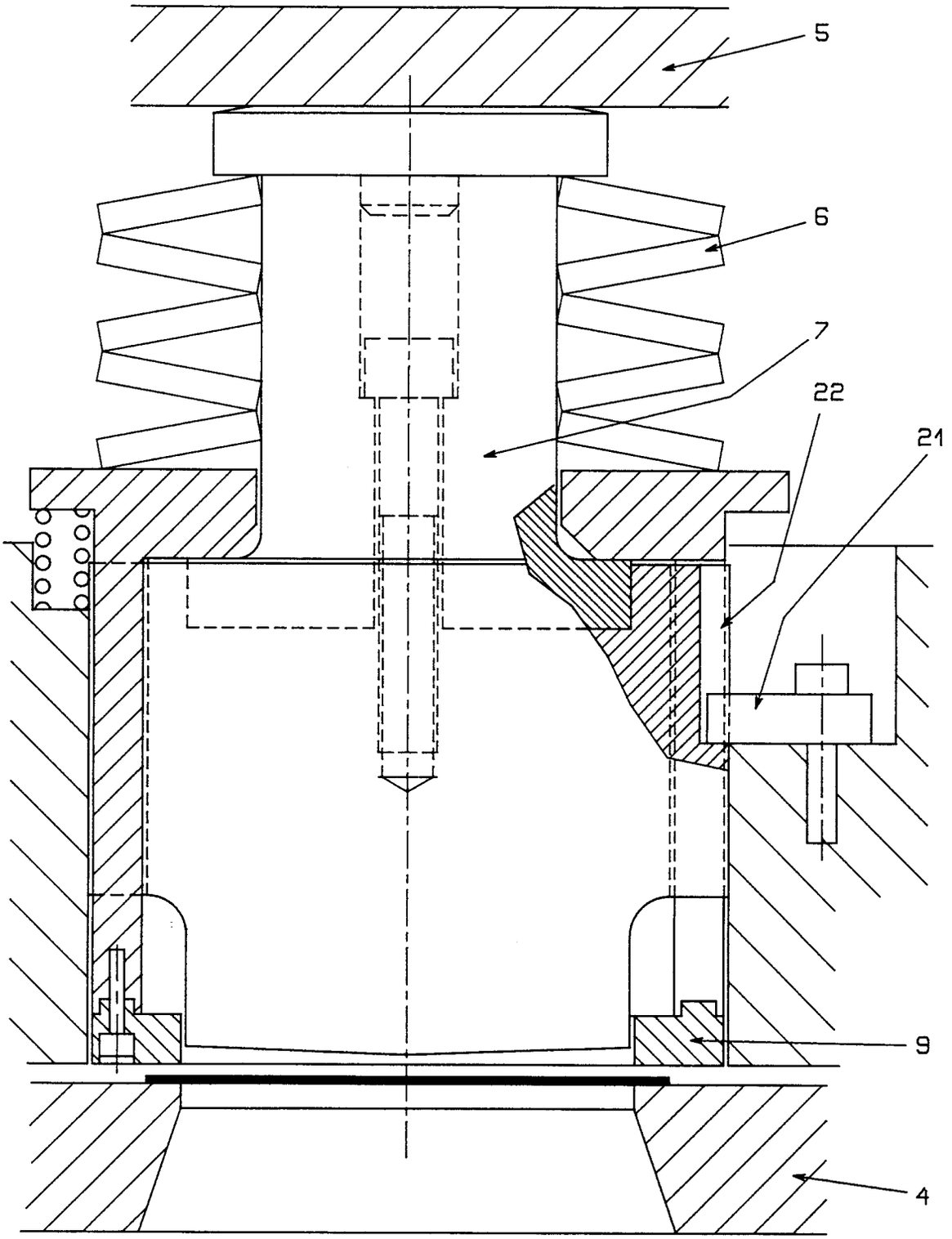


Fig.11

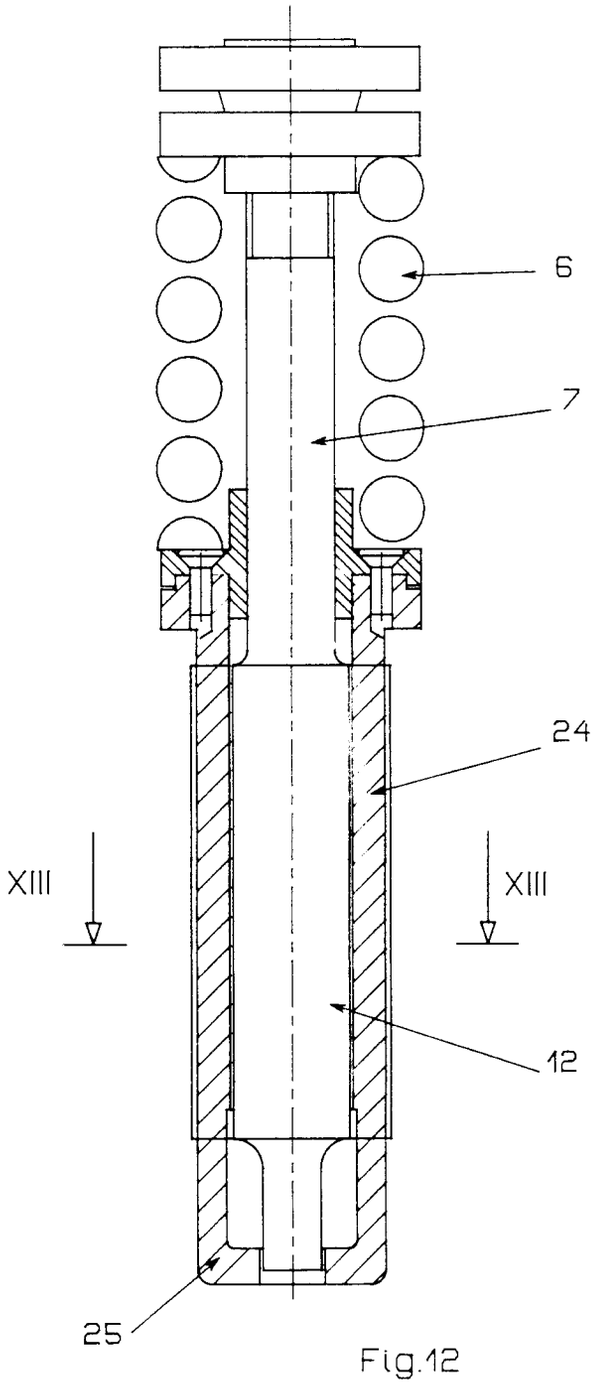


Fig.12

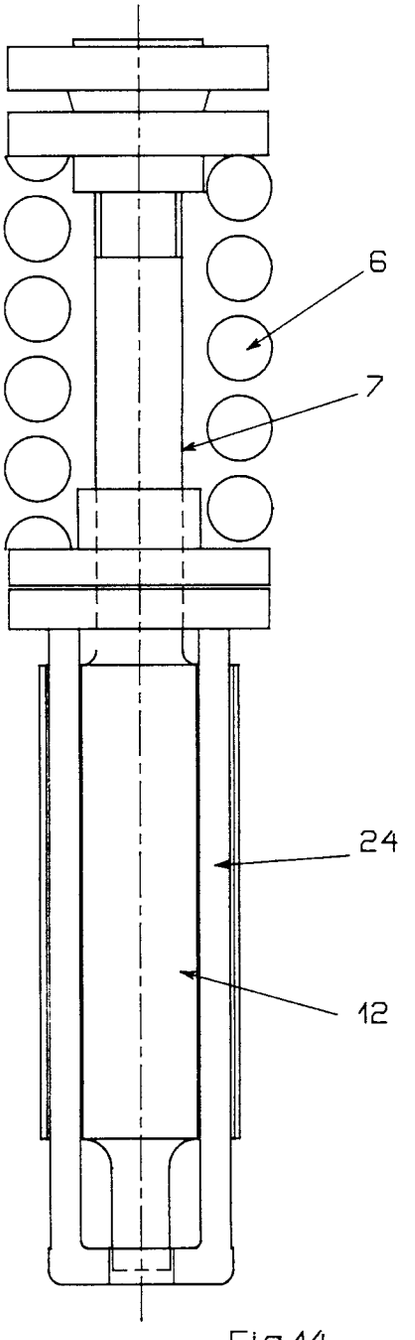


Fig.14

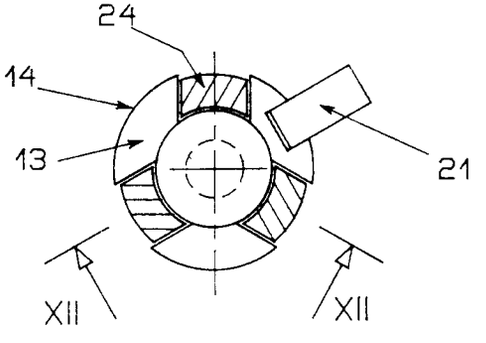


Fig.13

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# EUROPEAN SEARCH REPORT

Application Number
EP 96 10 0505

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (Int.Cl.6) |
|---|---|---|---|
| X | US-A-3 566 730 (PANCOOK JAMES J) 2 March 1971 | 1 | B21D45/00 |
| A | * figure * | 2,4,5 | |
| A | EP-A-0 000 762 (HOUDAILLE INDUSTRIES INC) 21 February 1979 * the whole document * | 3 | |
| A | US-A-4 041 817 (NELSON PAUL CHRIS) 16 August 1977 * abstract; figures * | | |
| A | US-A-3 933 071 (DORING EDWARD J) 20 January 1976 * abstract; figures * | | |

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

B21D

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| THE HAGUE | 16 April 1996 | Ris, M |

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